Iot Cloud: In Health Monitoring System

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Abstract: In the current situation, we come across various problems in health sector which can be solved with different ideas. Existing patient monitoring system, even in multispecialty hospitals are following traditional methods of maintaining records of patients in the form of hardcopies i.e., files, records, reports etc., which has lot of disadvantages and also this is not eco-friendly. In hospitals they also do various scanning, blood tests, X-rays and so on. But they provide reports of these in the form of hardcopies. What if the case, where they could upload data to a specific account, such that the doctor can easily checkout that and effectively provide medications to the patient? Currently available heart rate monitor watches or gloves are only used in gyms for fitness observations. Which is not actually connected to cloud for providing any graphs/reports, though it is not needed in that case. As health is the main point of concern, past and present record is much needed to diagnose correctly for present health condition. And in case the patient cannot describe the problem in detail, those records will do the job. In this research work attempts are made for implementation of patient monitoring system which consists of sensors connected to microcontroller, intended to acquire vitals from patient body. The accumulated data is synced to the Firebase database account of a particular patient. The uploaded data is utilized for generating reports in daily or weekly basis so that the report is very helpful for the doctor to diagnose fairly and quickly.

Keywords : Firebase, Vitals, *Medications,* Fitness, Microcontroller**,** Database

1 INTRODUCTION

The Information and communication technology (ICT) in the field of healthcare and advancement of mobile computing, networking topologies has been helpful in improvement of mobile health monitoring (MHM) [1]. Present health care systems with the utilization of cloud support and internet services, helps in improvement of rural health care services [2]. The vitals acquired from the patients are transferred via internet connection then the physician in the other side gets the data and analyse by himself then provides suggestions from far distance itself. But the data could be processed well so that the clear picture about the patient is obtained. Essential data and information helps in improvement of quality of health care services. IoT(Internet of Things) becomes an emerging concept where various IoT devices communicates, and are interconnected facilitating various advantages in forming a cloud computing devices [9]. The human body temperature can be accumulated precisely using analog sensor. And body temperature is also an effective vital to be measured [3]. Heart rate is one of the powerful tool to know about the status of a person's health and it is not only beneficial for maintaining fitness but also considerable in spotting potential health issues [4]. Example for proposed method is taking ECG database from MIT Data base and compress the multichannel ECG data and the result use for the analysis or comparison [13]. In today's world population is increasing rapidly and the concern towards the health of these is also increasing simultaneously [5]. So, there is a need for well-equipped health care centres which should be well maintained and developed. To support health care centres, to have an organized system which will allow proper maintenance of records of patient's vitals: heart rate, body temperature and even Blood pressure, ECG report etc. acquired by the sensors throughout his/her hospitalized period or even after that, and generating the reports, has narrated in this research work.

2 METHODS

Electronic Vital acquisition system is connected to cloud through IOT devices the patient will have a unique account which can be accessed by him through login into the website named "HealthX" which is created for this project. The current paper focus on focusing on a generalized system in the country, which should be accessible to each and every person. For example, if a person having some health issues comes to hospital (using this system) if he gets his vitals checked, then it will be uploaded to his account with the current time and date. With that data he will get treatment from Doctor. Even suggestions got from doctor will be uploaded to same account with time and date attached. The main advantage is storage of all the data of patient vitals in single unique account held by patient, the patient might not want to carry all the past/previous records which he/she got from different hospitals or diagnostics centres etc. This generalized system will help doctor to diagnose efficiently with less confusions like present health care system do. This Work focused on giving solution to present patient monitoring system which creates ambiguity to both patients and Doctors i.e., maintaining all records (present/past) related to a patient "since his birth till his death" will be available at one site which helps a lot. When a new baby is born then an account can be created in hospital itself, the vitals of that baby will be uploaded to the website and condition of baby like any disease, Blood test report etc. Then succeeding checkup report can be uploaded. If in the case of change of doctor needed, then this old reports in his account will be very useful to new doctor to diagnose well with good knowledge of history of patient, whereas present system is lagging by this feature and hard copy of report is to be carried and some of reports may be missing, patients most often fail to correctly describe his problem.

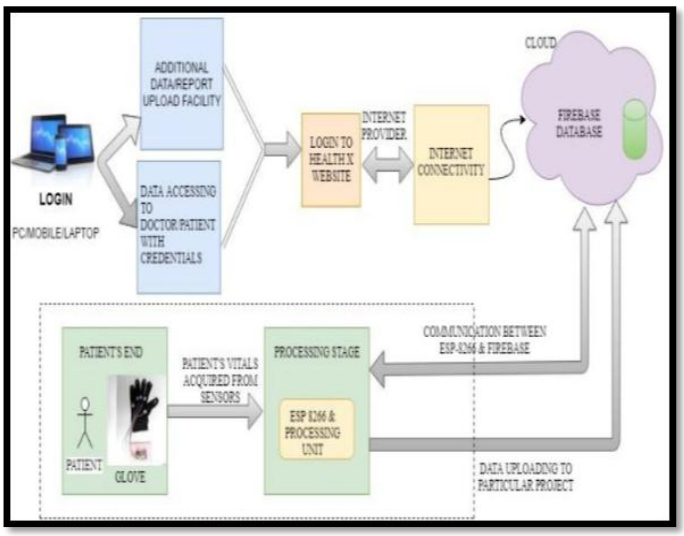

***Fig. 1**. Block diagram of proposed patient monitoring system*

If reports are correctly available and doctor would have clarity about his/her problem and proper medication can be provided. The idea is making a hand gloves which is having sensor to acquire vitals like heart beat rate, temperature and oxygen concentration and continuously uploading this vital to data base through ESP8266 and plotting graph weekly and monthly basis which Swill help doctor to know about the patient condition when he/she is in hospital or even after he/she get discharged. And they can login to website to get graphs/reports.

3 SYSTEM OVERVIEW

As shown in the Fig. 1 the system consisting of a glove to every patient/person who is in need to avail this service. Individual patient has his own glove which in sensors like heart rate, temperature etc., in contact with hand of patient. Once the patient wears the glove and turn it on then the Wi-Fi card will automatically connect to the specific Wi-Fi network. At the 1st stage the ESP8266 Wi-Fi card will connect to specified Wi-Fi network, communication takes place between the controller, firebase and the vitals are acquired through the sensor from the patient. The Fig. 2 shows the image of glove. The sensors are attached to the gloves in such a manner that the sensor will get heart beat rate readings from index finger. The glove is battery operable which is attached over the glove itself. At stage 2 the processed sensor data is then logged into firebase project named “HeathX”.The one main thing in this stage to be noticed is that the every unique patient is having his own account in the firebase so individuals data is stored separately which is very helpful for further processing using that useful sensor data..At the firebase once a new project is created with a name of patient a unique Id and secret key is given which is useful in logging the data to particular patient account itself.
At backend the available data of particular patient is then processed. The purpose of the HealthX Web Application as mentioned earlier is to monitor data with respect to particular patients. These data combined with interactive visualizations powered by Google Charts helps the doctors in identifying the variations with respect to the vitals over a period of time.

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***FIG. 2.** HAND WITH SENSORS AND CONTROLLERS*

The HealthX application as any other application consists of a front end and a back end that is constituted by a “Serverless Architecture” (In this case Firebase). Here is an extract from cloud.google.com on what a Serverless Architecture is: “Serverless is a new paradigm in computing wherein we are abstracting away the complexity associated with managing servers for mobile and API (Application program interface) backend, Data Processing Jobs, Databases and more.”
Going for a Server less Architecture brings in lot of advantages one of them being that we can easily scale our backend to meet the needs of increasing traffic. This is a crucial aspect because we don’t have to worry about managing systems/servers and it helps in focusing on the logic rather than the management.

4 HARDWARE AND SOFTWARE COMPONENTS REQUIRED

4.1 SOFTWARE COMPONENTS

Firebase: Firebase is a BaaS (Backend as a Service) platform that ships with Real Time Database, file storage, support for Analytics integration, and provides out of the box Authentication services along with Cloud functions.
Google Charts: Google Charts is an open source charting library developed using JavaScript that is meant to enhance web applications by adding interactive charting capability.

Vue.js: Vue.js is an open source JavaScript framework that is used to develop more complex and amazing User Interfaces

Web pack: Web pack is an open-source Java Script module bundler. It takes modules with dependencies and generates static assets representing those modules.

NPM: (Node Package Manager) Is a Package manager for the javascript programming language. It is the default package manager for the javascript runtime Environment node.Js.

4.2 HARDWARE COMPONENTS

Node MCU: "An open-source firmware and development kit that helps you to prototype your IOT product within a few Lua script lines" [10]. And sensors can also be effectively interfaced to this development board. The author has implemented the heart rate monitor prototype using NODEMCU which was motive to us to use tis module for this proposed patient monitoring system [11]. It consists of 10 GPIO, every GPIO can be PWM, I2C, 1-wire

Max 30100: Author has assessed that Max 30100 is an optical reflective type sensor which can be used to acquire Heart beat rate and Oxygen concentration level [12]. The MAX30100 operates from 1.8V and 3.3V power supplies, I2C compatible sensor module.

LM35 temperature sensor: LM35 is an 3-pin (i.e., Vcc, gnd,data)analog temperature sensor ,which can be used to measure human body temperature, 0.5°C Ensured Accuracy (at 25°C) known from the datasheet

5 RESULSTS AND DISCUSSION

In this research work attempts are made for implementation of patient monitoring system. The accumulated data is synced via IoT (Internet of things) device to the Firebase database account of a particular patient. The uploaded data is utilized for generating reports in daily basis so that the report is very helpful for the doctor to diagnose fairly and quickly. The proposed system shows the excellent sensitivity towards measurement of oxygen saturation and pulse rate of the patient, while conducting experiment with healthy person it gives accuracy up to 95%. It has been cross verified using pulse oximeter available in the market.

The experiment is conducted using the prototype glove attached with heartrate, oxygen concentration and temperature sensors. A glove is made to wear by a specific person, intended to monitor his/her vitals and a specific account is created in the name of patient in the HealthX website of this generalized patient health monitoring system.

For the purpose of experiment, a patient is made to wear the glove, and account is registered in the HealthX website and login to the website as shown in Fig. 3. Once the patient is weared the glove and sensed, then vitals like Heartrate in bpm, Blood oxygen concentration, Body temperature with time and date attached are being uploaded to the Firebase database automatically and login to the website using this url [6]. At the backend the graphs are plotted using the accumulated data from the patient. For experimental purpose a patient is made to wear the glove at different intervals so the graph obtained at different time intervals as shown in Fig. 5.

Fig.5 shows the graph plotted:

- Heart beat count per min v/s date
- Body temperature in degree Celsius v/s date
- Oxygen concentration in blood v/s date

For this proposed system to be generalized in the HealthX website [7]. A feature of uploading documents like Blood test report, scanning report and so on of a particular person having a unique account in HealthX website particularly designed for this purpose [7].

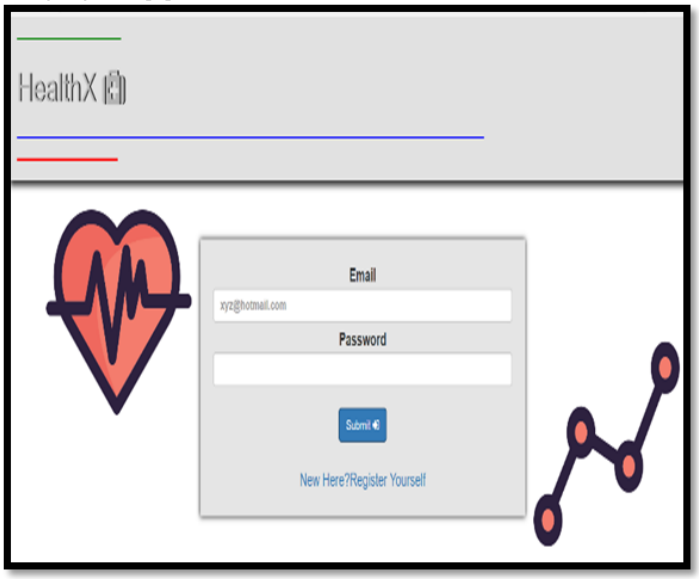

Fig. 3. *Front end login page for user in HealthX website*

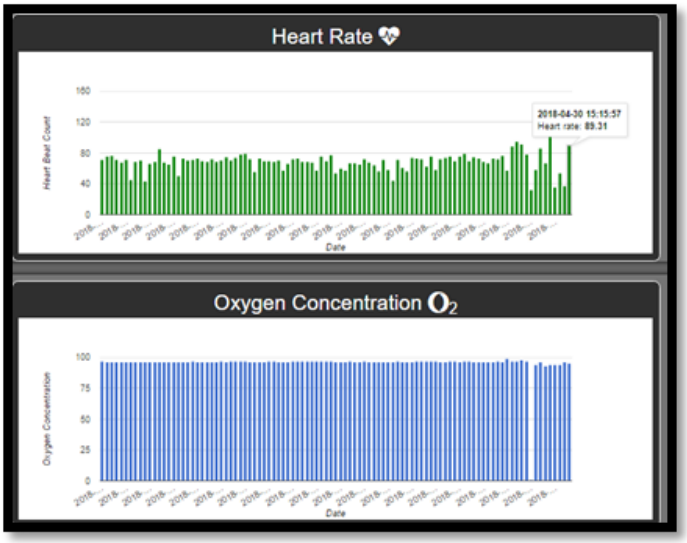

Fig. 5*. Graph representation of accumulated data from the patient*

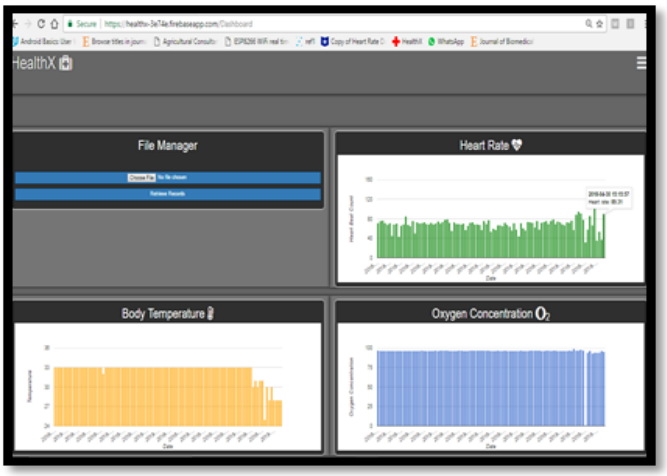

Fig. 4. *Graph representation of accumulated heart rate and oxygen*

concentration

6 CONCLUSION AND FUTURE WORKS

The proposed system shows the excellent sensitivity towards measurement of oxygen saturation and pulse rate of the patient, while conducting experiment with healthy person it gives accuracy up to 95%. It has been cross verified using pulse oximeter available in the market. These gloves can be used to monitor blood oxygen saturation and pulse rate during the course of operation and in unconscious condition. This system can also be used to access the above said data for the doctor even when he is not in hospital and medicate the patient, furthermore the documents can be digitalized and accessed at any point of time. The proposed framework allows a person to digitally store all the documents/records regarding to health since the birth till death, for that options available in the website. All the history records till the date is very helpful to any physician to diagnose a patient accurately. And if the patient needs to monitor his vitals then using the glove. Correspondingly graph is generated at the backend that is also available at patient's account at front end that can be produced to physician for proper diagnose. The current application visualizes the real time data from the firebase database. The application can include a model that can be trained on the go using the data from the database to predict the vitals of a patient for a future date. This helps the person identify any spikes in the vitals and accordingly precautionary measures can be taken. The advantage of future improvements in the field of IOT devices and advancement of medical equipment's can be integrated to this system to make the system general that can be used by any person. The location information of a user can be obtained by integrating global positioning system to this patient monitoring, which also helps in safety monitor for dementia patients. The aim in future development is to develop a mobile application, which will be helpful for the user to get the history records or reports easily from this application itself. These gloves can be used to monitor blood oxygen saturation and pulse rate during the course of operation and in unconscious condition. This system can also use to access the above said data for the doctor even when he is not in hospital and medicate the patient, furthermore the documents can be digitalized and access at any point of time.

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